CS01-111

1. A process to manufacture a non-volatile memory structure, comprising:

providing a silicon body having an upper surface;

growing a tunnel oxide layer on said upper surface;

depositing a layer of germanium doped silicon dioxide onto said tunnel oxide layer;

depositing a capping layer onto said layer of germanium doped silicon dioxide; and

rapid thermally annealing the structure whereby germanium nanocrystals are formed in said germanium doped silicon dioxide layer, ion implant damage is repaired, and source and drain region dopants are activated.

2. The process described in claim 1 wherein said silicon body is P-type;

3. The process described in claim 1 wherein the step of growing said tunnel oxide layer further comprises rapid thermal oxidation in a dry oxygen ambient.

4. The process described in claim 3 wherein the step of rapid thermal oxidation is heating at between about 900 and 1,000 °C for between about 5 and 60 seconds.

5. The process described in claim 1 wherein said tunnel oxide layer is grown to a thickness that is between about 2 and 5 nm.

6. The process described in claim 1 wherein the step of depositing a layer of germanium doped silicon dioxide further comprises using low pressure chemical vapor deposition or plasma-enhanced chemical vapor deposition.

7. The process described in claim 1 wherein the step of depositing a layer of germanium doped silicon dioxide further comprises reacting silane in a mixture containing between about 5 and 30% germane and an oxygen source.

8. The process described in claim 7 wherein said oxygen source is ozone or nitrous oxide.

9. The process described in claim 1 wherein the step of depositing a capping layer onto said layer of germanium doped silicon dioxide further comprises using low pressure chemical vapor deposition or plasma-enhanced chemical vapor deposition.

10. The process described in claim 1 wherein said capping layer is silicon oxide or silicon nitride.

11. The process described in claim 1 wherein said capping layer is deposited to a thickness between about 10 and 50 nm.

12. The process described in claim 1 wherein the step of rapid thermally annealing the structure further comprises heating at a temperature between about 800°C and 1,000°C for up to 300 seconds in a non reactive gas.

13. The process described in claim 12 wherein said non reactive gas is argon or nitrogen.

14. The process described in claim 1 wherein said nanocrystals have a mean diameter between about 2 and 10 nm.

15 . A process to manufacture a non-volatile MOS based memory device comprising:

providing a silicon body having an upper surface;

growing a tunnel oxide layer on said upper surface;

depositing a layer of germanium doped silicon dioxide onto said tunnel oxide layer;

depositing a capping layer onto said layer of germanium doped silicon dioxide;

patterning said tunnel oxide, germanium doped silicon dioxide, and capping layers to form a gate pedestal;

using said gate pedestal as a mask, forming source and drain regions that abut said gate pedestal at said upper surface and extend downwards therefrom into said silicon body; and

rapid thermally annealing the device whereby germanium nanocrystals are formed in said germanium doped silicon dioxide layer, thereby forming said non-volatile memory device.

16. The process described in claim 15 wherein said silicon body is P-type;

17. The process described in claim 15 wherein the step of growing said tunnel oxide layer further comprises rapid thermal oxidation in a dry oxygen ambient.

18. The process described in claim 17 wherein the step of rapid thermal oxidation is heating at between about 900 and 1,000 °C for between about 5 and 60 seconds.

19. The process described in claim 15 wherein said tunnel oxide layer is grown to a thickness that is between about 2 and 5 nm.

20. The process described in claim 15 wherein the step of depositing a layer of germanium doped silicon dioxide further comprises using low pressure chemical vapor deposition or plasma-enhanced chemical vapor deposition.

21. The process described in claim 15 wherein the step of depositing a layer of germanium doped silicon dioxide further comprises reacting silane in a mixture containing between about 5 and 30% germane and an oxygen source.

22. The process described in claim 21 wherein said oxygen source is ozone or nitrous oxide.

23. The process described in claim 15 wherein the step of depositing a capping layer onto said layer of germanium doped silicon dioxide further comprises using low pressure chemical vapor deposition or plasma-enhanced chemical vapor deposition.

24. The process described in claim 15 wherein the step of rapid thermally annealing the structure further comprises heating at a temperature between about 800°C and 1,000°C for up to 300 seconds in a non reactive gas.

25. The process described in claim 15 wherein the step of rapid thermally annealing the structure serves, additionally, to repair ion implant damage and to activate source and drain regions.

26. The process described in claim 24 wherein said nonreactive gas is argon or nitrogen.

27. The process described in claim 15 wherein said nanocrystals have a mean diameter between about 2 and 10 nm.

28. The process described in claim 15 wherein said source and drain regions are N-type.

29. The process described in claim 15 wherein the step of forming source and drain regions further comprises diffusion through a hard mask.

30. The process described in claim 15 wherein the step of forming source and drain regions further comprises using ion implantation.

31. The process described in claim 15 further comprising formation of electrical contacts to said source and drain regions and to said gate pedestal.